

## Advances in Supply Chain Simulation

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#### **The Word: Logistics**



#### Logistique: l'application pratique de l'art de mouvoir les armées





Antoine Henri de Jomini, General 1836 AC





#### **The Word: Logistics**



# Logistics is the act of moving armies.

Alfred T. Mahan, Objects of the U.S. Naval War College. An Address 1888 AC





up with strategy.

#### **Supply Chain Management**

A Supply Chain (SC) should be viewed as a single entity that is guided by strategic decision making Keith R.Oliver Senior VP and Michael D.Webber (Consultants in Booz, Allen & Hamilton), 1982 Supply-chain management: logistics catches

SCM (Supply Chain Management) as an integrative philosophy to manage the total flow of a distribution channel from the supplier to the ultimate user Lisa M.Ellram (ASU), Martha C.Cooper (Ohio State University) 1990

The main stated objectives of the Supply Chain Managment are to lower costs and improve customer service.









## **Industrial Logistics**



# IndustrialLogisticsasFlowControl & Management........fromCommonSensetoScience

#### magna industria bellum apparavit Cornelii Nepotis, (55 BC) de viris illustribus





#### **Supply Chain Environment**





The outsourcing process between main and sub-contractors is often iterated at lower levels and a good on-line multi-level control is requested, while customer needs drive the processes



#### Decision Making Evolution & Tool Expectations

For Instance in an Industrial Company logistics, in order to meet lean production requirements, the Tools evolved:

"frozen" fixed purchase orders



…open contracts regulated by agreements …...

...partnership with mutual info exchange... ~

...web application enabling simulation...

Supply Chain Actor Federation....



### **Supply Chain Simulation**

- Why Simulation in SCM:
  - Many Stochastic Elements
  - Many Elements
  - Many Variables
  - Many Interactions
  - Many Multidependent Phenomena
  - Many Different Range of Validity







#### Even the Simplest Case need M&S





#### Supply Chain New Challenges

Today SCM faces new Challenges such as:

- Capability to Guarantee Flows
- Sustainability
  - Economic
  - Social
  - Environmental
- Safety & Security





### Different Methodologies for Supply Chain Control Strategies

easy

Static

critica

Dynamic

ThePossibleControlalternativesfortheSupplyChainManagementaresummarized as presented:





#### A Basic Aerospace Logistics as Complex Case for NSCM

- A Case for Netcentric Supply Chain Management: Executive Aircraft Logistics Goal is to procure:
  - → Right Items 15.000 items/plane
  - in the Correct Place 2 production sites 21 workstations



Plane Lead Time: 2 year Component Lead Time:3-16 months

with Minimum Cost Buy Items: 3 M Euro/plane Manpower: 15.000 hours/plane



#### Where are the Resources?

- In Aerospace Logistics resources are:
  - Production Sites
  - Services Centers
  - Flying Fleet
  - + Component Providers
  - > Transport Resources



Resources Distributed WorldWide among different Entities and Systems, Linked by the Web



#### What we could Exchange?

- In Aerospace, great benefits could be provided by sharing:
  - → Failures Data
  - Spare Part Inventories
  - Fleet Situation
  - Configuration Evolution
  - Mission Planning
  - Service Planning
  - Production Planning



#### Fleet Net-Centric Management

This is a radical conceptual change feasible by current technologies with existing systems; in aerospace context this could provide terrific savings and service improvements both for Civil and Military Users



#### Net-Centric Management Goals

- Today, Supply Chain Net-Centric Managements needs to face:
- Different Geographically Distributed Process Control Systems
- → Complexity in
  - Production/Assembly Processes
  - After Sale Services Processes
- Models for Coordination of many subjects
- Dynamic Evaluation of Options and Opportunities
- Encapsulated Models for guaranteeing Proprietary Issues and Strategic Know-How as well as Classified and Confidential Data and Models

#### **Interoperable Simulation**







#### **Interoperability as Solution**

A Federation of Interacting Simulators and DSS (Decision Support Systems) located at the Actor HQ & Sites, representing the Supply Chain, supports:

- Distributed Operation Planning by Model Interoperability without exchanging Strategic Confidential Data
- On line/Real Time Control along the whole Supply Chain
- Dynamic Decision making Based on Distributed Simulation
- Alternative Solution evaluation for Operative Support







# Why Agents in Supply Chain Netcentric Management?

- Supply Chain Netcentric Management is turning to a key aspect for the future development of the manufacturing sector
- Traditional application of the classical production management techniques cannot be directly applied
- For Supplier serving two o more party a certain degree of competition among the order priority can occurs
- An Agent Based approach is supposed to more efficient: Actors in a Supply Chain are able to "Sense and React" upon the external world stimuli
- Experiencing Agent Based Model for supporting the Optimization of a Complex Supply Chain in Aerospace Industry.





#### **Federation Architecture**





## **HLA Federation Example for SCM**





#### **Interoperability Example: Agent Based Negotiation**





#### **Virtual Ports**

- Training for New Device
- Engineering New Solutions
- Taking care of Security & Safety



SEAPORT Simulator



#### Interoperable M&S for Plant as Supply Chain Element

- Optimizing Layout
- Considering Interference due to Physics (i.e. noise, vibration)
- Evaluating Re-Location
- Evaluating Production Transfer
- Evaluating Impact on the Supply Chain
- Virtual Analysis of the Production Site Movement





#### **Green Logistics &** Simulation

- Analyzing Sustainability and Efficiency of SC ٠
- Improving External Marketing ٠
- Market Reputation (Trade partners, Institutions, ٠ **Consumers**)
- Internal Company Reputation (i.e. survey Great •

place to work) **Opportunities for Cost Reduction** (i.e. solution for reducing wastes or packaging)



GL - GreenLoc

425 400

**Environmental Impacts** 

L'impatto ambientale misurato.

415.51 tCO2/anno

0.87 tCarta/anne



#### Power as Product of a Service Supply Chain

- Power Business is supporting Power Plant and Equipment Development
- Most of the Equipment are sold at cost price
- 50% of the Profits comes from Service
- Logistics Services are the key strategies for improving performances and profits





RESET is a project, devoted to creating a Federation for supporting training in river navigation and logistics. The Simulators includes:

- **Barges**
- Tanks

MINISTERO DEL LAVORO E DELLA PREVIDENZA SOCIALE Divisione Generale per le Politiche per l'Orientamento e la Termanican

Unione europea

Fondo sociale europeo

The RESET Federation includes the river dynamics for reproducing the maneuvering in condition affected by different streams, variable deep.

RegioneLombardia



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KATOEN NATIE

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#### Conclusions ... ...of Part I



- Supply Chain Lean Solutions and Quick Response requires advanced distributed solutions based on Modeling & Simulation
- Interoperability and Simulation are strategic issues for succeeding in Supply Chain Management
- A Critical Issues for Success within this context:
  - Properly Define Overall Goals
  - Realistic Objectives



Matching Experts, Users and Developers